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On the unknown cortical structure in *Urceolaria (Ciliata-Peritricha)*

O nieznanej strukturze kortikalnej u *Urceolaria (Ciliata-Peritricha)*

Thanks to the kind assent of the directing body of the Institut za Oceanografiju i Ribarstvo, Split, and the Institut za Biologiju Mora, Rovinj (Yugoslavia), the present author had the opportunity to collect, alongside other material, some amount of *Urceolaria patellae* Cuènot 1891 from the gills of the Middle and North Adriatic *Patella coerulea*; the material was collected in the autumn 1957.

In studying the species mentioned, the $AgNO_3$ impregnation method after B. Klein as modified by the present writer for examining the maritime material was applied; the present author had already tested this method which consisted in the following: the material dried on a slide was rinced in fresh water thus diluting and removing the salt; next, the preparation was dried for the second time and, after adding 2 per cent. $AgNO_3$ solution, it was exposed to the effect of sun light. This proceeding made it possible to abtain good pictures of the argyrophile system of varius *Ciliata* (see Raabe 1958), and of that of *U. patellae* Cuènot among others.

Urceolaria patellae Cuènot 1891 resembles in shape a low cylinder with slightly bulging sides and with parallel oral and aboral surfaces. The body is 27 to 60 μ in diameter and 15 to 50 μ in height. A double, evolutive left-handed adoral spiral runs around the apical pole of the body forming a 400° turn; it ends in a loop from which rows of cilia penetrate deep into the infundibulum. The aboral sucker, 10 to 22.5 μ in diameter, is located on the opposite pole of the body; it is surrounded by a crown of cilia forming a ciliary girdle and by another crown of less dense but stronger marginal cilia. These marginal cilia — called "cirri" by several authors — do often deviate from the plane as is outlined by the sucker margin and by the developed ciliary girdle, and run along the body flanks towards the oral shield. The sucker is reinforced by a skeletal ring consisting of 13 — 16 (15 on most occasions) smooth links overlapping each other like tiles. The macronucleus has a peculiar structure consisting of a lentil-like compact central part located above the bottom of the sucker, and of two bow-like bent elements resembling sausages; the latter are located slightly over the central part of the body and are connected by thin fibrillae starting off the middle part of the sausages and reaching to the both sides of the central part. The micronucleus is relatively very large and well visible; it is situated a little over the central part of the macronucleus.

Urceolaria patellae has been examined by Cuènot 1891, and by Caullery et Mesnil 1915 (the conjugation). However, none of these authors has described it sufficiently nor published any good drawings of the animal. On the contrary, it was very well described by Brouardel 1951. There is also a good description of a very similar (or perhaps even identical) species — *Urceolaria korschelti* Zick 1928 from the gills of *Chiton margaritanus*. However, no one of those authors payed attention to the cortical structure.

The $AgNO_3$ impregnated preparations ravealed relatively poorly the structure of the sucker even much more worse than in the representatives of the genus *Trichodina* examined at that same period by the present author in the Adriatic Sea (Raabe 1958). This seems a general character of *Urceolariidae* with a smooth skeletal girdle for the same is true of the sucker

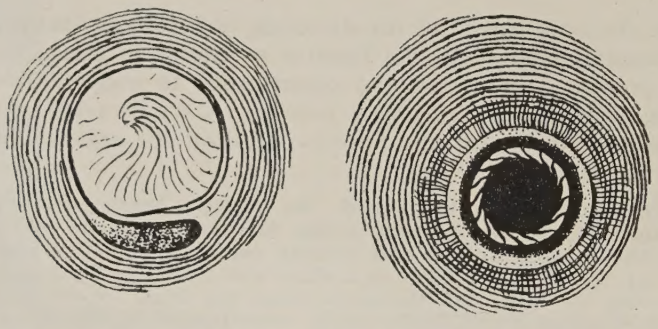

Fig. 1. *Urceolaria patellae* Cuènot. $AgNO_3$ preparations from the oral, aboral, and lateral sides

structures of *Urceolaria mitra* v. Siebold 1850 from fresh water *Turbellaria* or from *Trichodinopsis paradoxa* Clap. Lachm. 1862 from terrestrial *Prosobranchia* — *Cyclostoma elegans*. The fact that the skeletal girdle structure reveals itself so poorly (while it usually occurs so clearly in the genus *Trichodina* representatives) seems to result from its being located deeper under the pellicle in *Urceolaria* and *Trichodinopsis* than in *Trichodina*.

Still, in successfully executed preparations, distinct skeletal girdle links — tightly overlapping like tiles — appeared in *Urceolaria patellae* too. The adoral ciliary spiral could be impregnated incomparatively better, revealing its double-row structure: the inner "polycinétie" and the external "haplocinétie (terms applied by Chatton et Villeneuve 1937). There was, however, a very characteristic feature: while the apical surface of the body within the adoral spiral could be impregnated very poorly but still absolutely uniformly in many species of the family *Urceolariidae* as were examined by the present author, it exhibited some structures in *U. patellae* (even if these were not very distinct): radial stripes run from the interior row of the spiral towards the middle of the shield going over into a delicate network in the middle of the apical field. The disposition of the meshes in the central part of the shield thus concentrated around two centres situated near each other.

However, the most substantial and the most surprising structure as is steadily and easily revealed on the *Urceolaria patellae* body by means of $AgNO_3$ impregnation is a series of rings arranged in parallel planes and encercling the lateral walls of this ciliate; the rings are 20 (average) in number and 1.5 μ distant from each other. The rings appear directly after the adoral spiral running parallelly to the latter and reach as far as the adhesive disc being parallel to its circumference too. Thus, the lateral walls of the cylindrical *U. patellae* body are covered with $AgNO_3$ impregnable rings that apparently run within the pellicle. These rings are formed by thin fibrillae with small grains on them at irregural distances resembling knotes on a thread. All of the rings are closed up.

The present author's *Urceolariidae* material covers more than 30 species in the form of good and very good $AgNO_3$ impregnated preparations; yet, he never before had met with similar structures. At any rate, they do not occur among the representatives of the genus *Trichodina* Ehrbg., *Trichodinella* Šramek-Hušek, *Dogielina* Raabe, *Semitrichodina* Kazubski. Neither did they occur in numerous species examined by Lom 1959, 1960. Finally, they did not occur in *Urceolaria mitra* v. Siebold very good preparation which — executed by Janina Raabe — were available to the present author.

Consequently, the fibrillae surrounding the body may be considered an absolutely exceptional phenomenon among the *Urceolariidae,* which most probably occurs solely among some of the representatives of the genus *Urceolaria.*

Out of the representatives of the genus *Urceolaria,* i.e. *Urceolariidae* with the adoral spiral forming a large bow somewhat exceeding 360° and equal or exceeding the diameter of the sucker, and with the skeletal ring consisting of 10 — 20 denticles (in contrast to *Trichodinopsis* with its far smaller radius of the adoral spiral, and with its links numbering as much as approximately 50) — solely *Urceolaria mitra* v. Siebold, the typical species of the genus, has been well known to the present writer. The $AgNO_3$ impregnated preparations clearly disclose the form of the adoral spiral which — in *U. mitra* — is arranged in the shape of a cardioid; it also discloses — when the impregnation is a success — the structure of the sucker with its ciliary girdles and with the distincly overlapping links of the skeletal ring. Yet, no fibrillae surrounding the body nor any structures on the oral surface of the body were ever shown; even not in the best and finest preparations. It might well be supposed that the structures as were discovered by the present author on the body of *U. patellae* were disclosed due to $AgNO_3$ effect on maritime organisms, i.e. on such ones in which the NaCl content was considerable disregarding the rinsing, and thus resulting in a somewhat different $AgNO_3$ reaction. However, this supposition is contradicted by the fact that similar structures were not disclosed in other maritime *Urceolariidae* as were treated in the similar manner, on the one hand, and by their absolutely identical occurrence both in the saltwater and in some fresh-water *Peritricha-Sessilia,* on the other.

The very interesting and amazingly close examinations of *Urceolaria mitra* v. Sieb. carried out by Peshkovskaya 1923 point out to the occurrence of complex subpellicular structures in this species; some of them exhibit

features resembling those observed by the present writer in *U. patellae*. For Peshkovskaya gives, by the way, a description of a fine fibrillae system running from the interior row of the adoral spiral towards the centre of the cardioidal oral shield interlacing there to form a fine network ("the inperistomal fibrillar netting" — Peshkovskaya). The fibres and meshes of this network concentrate in two centres joining the myonemes as are running from the oral surface towards the aboral one, i.e. towards the sucker surface of the ciliate's body ("the rear retractor of the throat" and "the trunks of the dorso-ventral side myonemae" — Peshkovskaya). The points where this "fibril netting" joins the myonemes show as a kind of whirepools in the surface structure. The structures described by Peshkovskaya are doubtlessly the subpellicular systems much the same as the similar net, which — according to the authores mentioned — encloses the whole body of *U. mitra*. These structures have not at all appeared on the present author's $AgNO_3$ preparations of *U. mitra*.

To the present writer's mind, the above described fibril structures on the oral disc of *U. patellae* correspond to the "peristomal fibril netting" described by Peshkovskaya, and their appearance in *U. patellae* could well be attributed to the peculiar chemical reactions occurring in the salt water organisms as they did not disclose in silver impregnated preparations of *U. mitra*. At any rate, surprizing is the resemblance of both of these network systems as well as the fact that the "whirl-like" torsion may be seen sufficiently distinctly also in *U. patellae*. However, it could be not established whether these whirls were concentrated in *U. patellae* around two centres similarly as in *U. mitra*; yet, the myonemes may well be arranged in a different way in *U. patellae* than in *U. mitra* with its highly developed organization in this respect.

The close and meticulous examinations carried out by Peshkovskaya, who dealt mostly with the cortical structures of the walls of the *U. mitra*'s body, did not disclose any ring-like structures (however, they showed the occurrence of the peculiar fibrillar network). Other methods have neither disclosed such structures.

Apparently, somehow similar structures occur only on the body of *Trichodinopsis paradoxa* Clap. Lachm. 1862 which fact the present author was able to confirm in the $AgNO_3$ impregnated material from the intestine of *Cyclostoma elegans* from Tihany, Hungary. Parallelly overposed rings encircle the side wall of the conical body of *T. paradoxa* too; however, these rings do not look like thin „threads with knotes", neither are they continuous consisting of irregular, short and bow-like bent sections. Everything points to this being a picture of the surface sculpture the dark, bow-like sections being the hollows composing the circular furrows around the body; these furrows may be observed in both the in vivo and the preserved material as well as in the stained one; they have been described by many authors. Symbiotic *Spirochaetae* accumulating in these furrows form the peculiar "pseudociliature" of *Trichodinopsis paradoxa* Clap. Lachm. (see Fauré — Fremiet 1909, Cepède et Villem 1911).

Thus, the circular furrows covering the body of *Trichodinopsis paradoxa* Clap. Lachm. $AgNO_3$ impregnable, do under no aspect correspond to and are not homologous with the structures observed by the present author

in *Urceolaria patellae* Cuènot, the dark interrupted lines being a picture of the sculpture of the pellicle surface in *Trichodinopsis*, while the dark lines surrounding the body of *U. patellae* are the picture of rather subpellicular structures, most probably corresponding to the argyrophilous system.

Yet, the rings of *U. patellae* have their equivalents in numerous *Peritricha-Sessillia*; the present writer has often met occasionally with this fact in carrying out his investigations. These rings have been clearly disclosed by Dobrzańska 1961 in her *Orbopercularia raabei* preparation. Particularly clear and distinct, these rings have been in *Scyphidia physarum* Lachm. found by the present writer on the gills of *Theodoxus fluviatitis* L., both in the brakish inshore waters of the Baltic Sea and in the hill streams of Southern Yugoslavia.

The body of *Scyphidia physarum* Lachm. is cylindrical in shape, slightly tapering towards the oral pole while it widens to form a wide sole at the basal or aboral pole. The adoral spiral usually shrinks post mortem so that it may be seen in very few preparations only. The entrire body is encircled by argyrophilous rings resembling thin threads with distinct „knotes" of dark corpuscules. These structures cover with concentric rings the widened sole also in *Scyphidia*; yet, they do not occur on its bottom side, on the thigmotactic one. All of these lines are closed up, and they run quite regularly.

There is no space here to consider the nature of these structures on the body of *Scyphidia* and other *Peritricha-Sessilia* as well as on that of *Urceolaria patellae*. They resemble, in appearance, the kineties of *Holotricha* and react in a similar way when stained; their arrangement too resembles that of the kineties mentioned above. Their circular arrangement in *Peritricha* corresponds to the circular arrangement of the adoral spiral and to the ring-like arrangement of the aboral kineties in the aboral ciliary system of the telotrochs of *Peritricha-Sessilia*, or to the girdles surrounding the sucker of *Peritricha-Mobilia*. At the present moment, the question is solely to emphasize the similarity or identity of the circular lines in *U. patellae* and in *Peritricha-Sessilia*.

The occurrence of circular fibrillae with fine corpuscles around the body of many *Peritricha-Sessilia* representatives (*Scyphidia* belonging to their number), and around the body of *Urceolaria patellae* Cuènot (from *Urceolariidae*) could lead to an interesting conclusion: since *Urceolariidae* are supposed to originate from the telotroch forms of *Peritricha-Sessilia* (see Raabe 1952), the occurrence of these fibrillae in *U. patellae* could be regarded as an ancestral character which already had disappeared in other *Urceolariidae*. It would then be a plesiomorphic character in *U. patellae* Cuènot.

To be sure, it is not possible to decide right now whether this character remained solely in *U. patellae* or it might occur in other *Urceolariidae* species too. As was already stated above, the present author's experience with numerous representatives of *Trichodina, Trichodinella, Dogielina, Semitrichodina* species and, finally, with those of *Urceolaria mitra* failed to confirm the occurrence of any circular fibres in them disregarding the $AgNO_3$ impregnation methods applied. From the representatives of the genus *Urceolaria*, *U. mitra* alone was examined by this method (Šramek-Hušek, Raabe); consequently, the occurrence of circular fibres may be not excluded in the representatives of this genus.

Especially such species as *U. urechi* (Noble 1940) and *U. korschelti* Zick 1928 (and probably *U. serpularum* Fabre-Domergue 1888 too) so extraordinarilly closely related to *U. patellae* Cuènot, may be supposed to have this character. The descriptions by Noble 1940, Zick 1928, and the present writer's own observations have confirmed the general body shape and its dimensions as well as the topography of organelles, the adhesive disc structure, and finally, that extraordinary characteristic structure of the nuclear apparatus to coincide in their finest details in all of these species. Besides, there is a coincidence in the character of conjugation of *U. patellae* and *U. korschelti*: a marked dimorphism of the conjugants, the microconjugants being many times smaller and perishing following completion of the sexual process. Some differences seem to exhibit *U. serpularum* Fabre-Domergue 1888 in the structure of its macronucleus: in representing the latter, Fabre-Domergue has not sketched the sausage-like bent elements; however, this relatively remote author might well be supposed to have simply overlooked these elements. To be sure, it would be desirable to investigate the problem of the circular cortical fibrils in all of these so closely related species.

Nevertheless, irrespective of any further investigations which eventually would confirm the circular fibrillae in all four of these species, the latter are anyway clearly distinct from all the remaining representatives of the genus *Urceolaria* Stein 1867, and especially so from its typical species — *Urceolaria mitra* v. Siebold 1850. It may be assumed that a future systematic revision of the family *Urceolariidae* will result in singling out from the genus *Urceolaria* of the typical subgenus alongside with another one, represented by the type of the *U. patellae* Cuènot 1891 form. The substantial characters of this subgenus should be: a peculiar and characteristic arrangement of the nuclear apparatus and the occurrence of cortical structures around the lateral walls of the body.

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STRESZCZENIE

Autor opisuje nie znaną dotychczas strukturę kortikalną na ciele *Urceolaria patellae* Cuènot ze skrzeli *Patella coerulea* z Adriatyku. Strukturę tę, ujawniającą się przy zastosowaniu impregnacji srebrowej, stanowią okólnie otaczające ciało włókna z drobnymi ziarnami. Autor porównywa tę strukturę z podobnymi utworami spotykanymi na ciele *Peritricha — Sessilia* i rozważa prawdopodobne jej znaczenie. Występowanie tej struktury na ciele *U. patellae* Cuènot, a brak jej u typowego gatunku rodzaju *Urceolaria*, a mianowicie *U. mitra* v. Siebold, autor uważa za ważną cechę filogenetyczną i taksonomiczną, która pozwoli prawdopodobnie wyodrębnić gatunek *U. patellae* i gatunki pokrewne w nowy rodzaj lub podrodzaj rodzaju *Urceolaria* Stein.

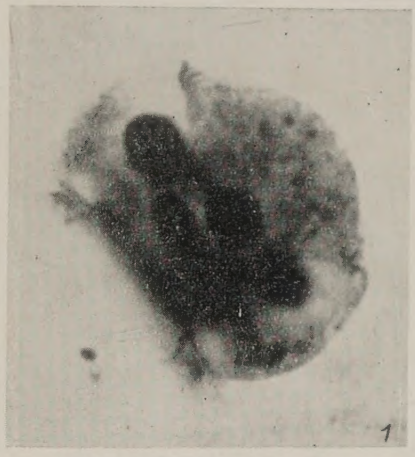
EXPLANATION OF PLATES I AND II

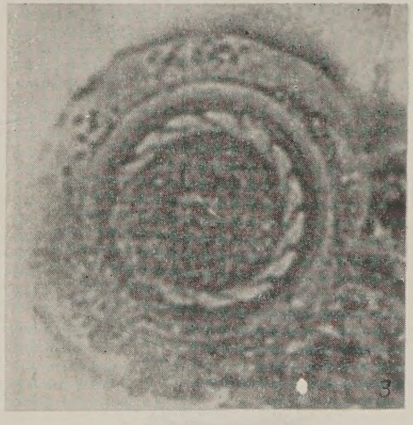
Phot. 1. *Urceolaria patellae* Cuènot, lateral view (I. H. preparation).

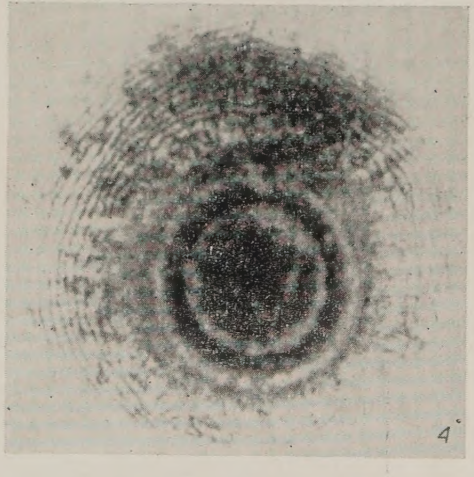
Phot. 2, 3, 4, 5 and 6. *U. patellae* Cuènot from the oral, aboral, and lateral sides ($AgNO_3$ preparations).

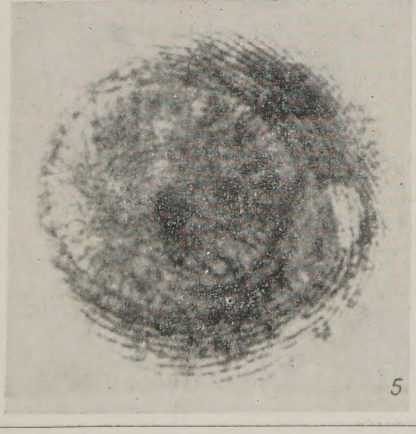
Phot. 7, 8 and 9. *Urceolaria mitra* v. Siebold from the oral and aboral sides ($AgNO_3$ preparations by Janina Raabe).

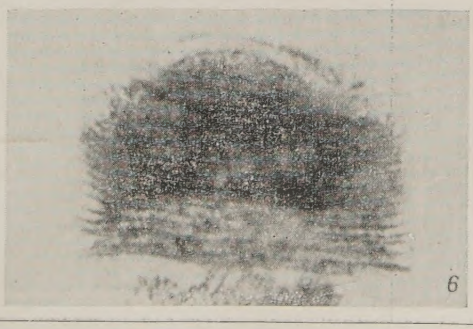
Phot. 10. *Scyphidia physarum* Lachm. ($AgNO_3$ preparation).











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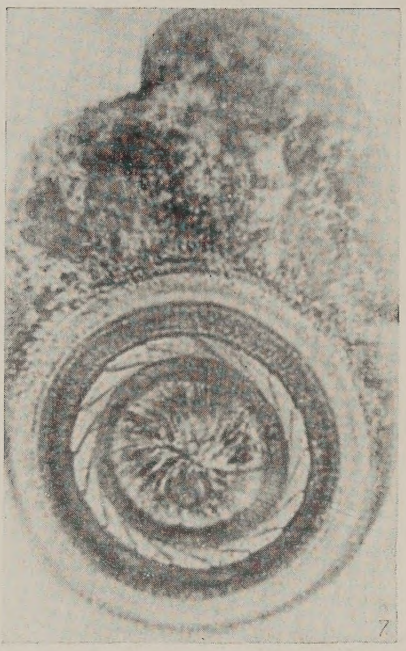

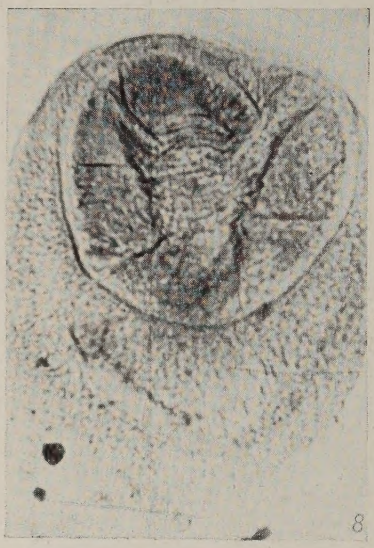

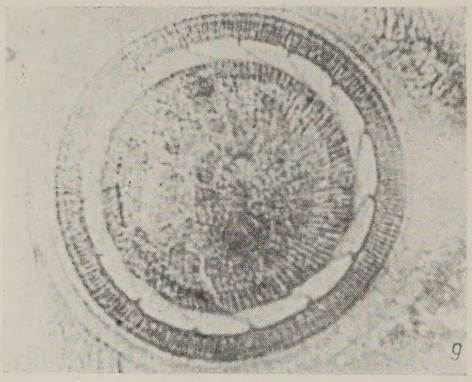

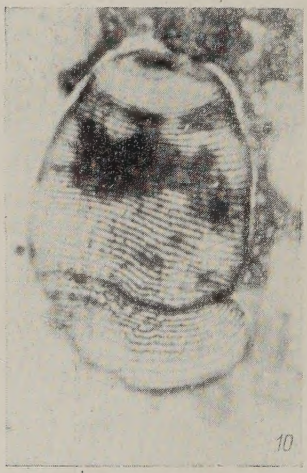

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